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VASCULAR PLANTS OF PU'UKOHOLĀ HEIAU NATIONAL HISTORIC SITE, HAWAI'I ISLAND

Technical Report 101

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TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

VASCULAR PLANTS OF PU'UKOHOLĀ HEIAU NATIONAL HISTORIC SITE, HAWAI'I ISLAND

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ABSTRACT

One hundred four vascular plant species were found within Pu'ukoholā Heiau National Historic Site in 1992-94. Seventy of these plants (67% of the total) were alien species (introduced since 1778). Fourteen plant species in the Park (13%) were originally Polynesian introductions, 13 (13%) were indigenous, and 7 (7%) were endemic. Sixty-eight plant species seen in the Park in 1992-94 were additions to the previous checklist of 1977. Twenty-two of the new Park records were found only in a lawn near the visitor center and 32 others were plantings in this area. Fourteen other plant species additions were seen primarily along trails and within a gulch. Sixteen plant species listed from Pu'ukoholā Heiau National Historic Site in 1977 (Macneil and Hemmes 1977) were not seen during the current survey; these were five native species of the scrub grassland and coastal communities and 11 alien species, including one shrub, one cultivated vine, and nine annual herbs.

ACKNOWLEDGMENTS

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INTRODUCTION

Pu'ukoholā Heiau National Historic Site (NHS) was established in 1972 to preserve important Hawaiian archaeological and cultural sites. The Park is named for Pu'ukohala Heiau, a massive war temple (luakini) built or rebuilt by King Kamehameha I, and also contains the remains of the house site of John Young, the King's English advisor (Kirch 1985). While the Park was not created to protect native vegetation, it does contain a number of native plant species and Polynesian introductions, both planted and naturally occurring. One previous plant survey was undertaken in 1975-76, and the results were a plant checklist, vegetation map, description of major plant communities, and an evaluation of roadside vegetation (Macneil and Hemmes 1977). The current plant survey of Pu'ukoholā Heiau National Historic Site is part of a larger project to monitor

the plants, birds, mammals, and invertebrates of three National Parks of leeward Hawai'i. Plant surveys of Kaloko-Honokōhau and Pu'uhonua o Hōnaunau National Historical Parks are presented in separate reports.

THE STUDY AREA

Pu'ukoholā National Historic Site is on the leeward shore of Hawai'i Island in the South Kohala District. Kawaihae Harbor is immediately to the north, and Spencer Beach County Park bounds the Park to the south. On the shore of Kawaihae Bay, most of the Park is west of the Waimea-Kawaihae Highway (State Highway 270), but a parcel containing the John Young house site is on the upslope or eastern side of the highway (Fig. 1).

Climate - The area near Kawaihae is in a rain-shadow produced by the Kohala Mountains and Mauna Kea and is the driest region in the state. Mean annual precipitation at Kawaihae is 223 mm (8.8 in). Rainfall is seasonal with most rain falling during winter months. Mean monthly precipitation ranges from a high of 50 mm (2 in) in January to a low of 6 mm (0.2 in) in July (Giambelluca et al. 1986). The mean annual temperature in the Kawaihae area is 24° C (76° F) (Hawaii State Dept. of Land and Natural Resources 1970).

Geology and Soils - Pu'ukoholā Heiau National Historic Site is on Mauna Kea Volcano near its interface with the older Kohala Volcano. While Mauna Kea last erupted approximately 4,500 years ago, the substrate of the Park belongs to the much older Hāmākua Volcanics, 0.27 million years before present (Petersen and Moore 1987). Soil within the Park is classified as extremely stony, very fine, sandy loam of the Kawaihae Soil Series. Soils of this series are 51 to 102 cm (20-40 in) deep over pahoehoe with a dark reddish-brown surface layer about 5 cm (2 in) thick (Sato et al. 1973). Park soils are moderately permeable and have relatively low moisture storage capacity (Macneil and Hemmes 1977).

Vegetation - The current vegetation cover of the Park is predominantly alien; the major plant communities are buffelgrass (Cenchrus ciliaris) scrub grassland and kiawe (Prosopis pallida) forest (Macneil and Hemmes 1977). These are recent plant communities. Buffelgrass was introduced to Hawai'i as a cultivated plant in the 1930s (St. John 1973); kiawe was first planted on O'ahu in 1828, and was later spread to other islands for cattle forage (Wagner et al. 1990). During the period of Hawaiian habitation, the vegetation of the Kawaihae area was probably more open and dominated by grasses. McEldowney (1983) reported that the lands near the coast at Kawaihae were called "pili" lands, referring to the prominence of grasses, including but not restricted to the indigenous pili (Heteropogon contortus). As grasses were important for thatching material, lowland grasslands were maintained by Hawaiians through the use of fire (Kirch 1982). Groves of native trees and Polynesian introductions were also present along the Kawaihae shore in the early historic period; land award documents and early accounts

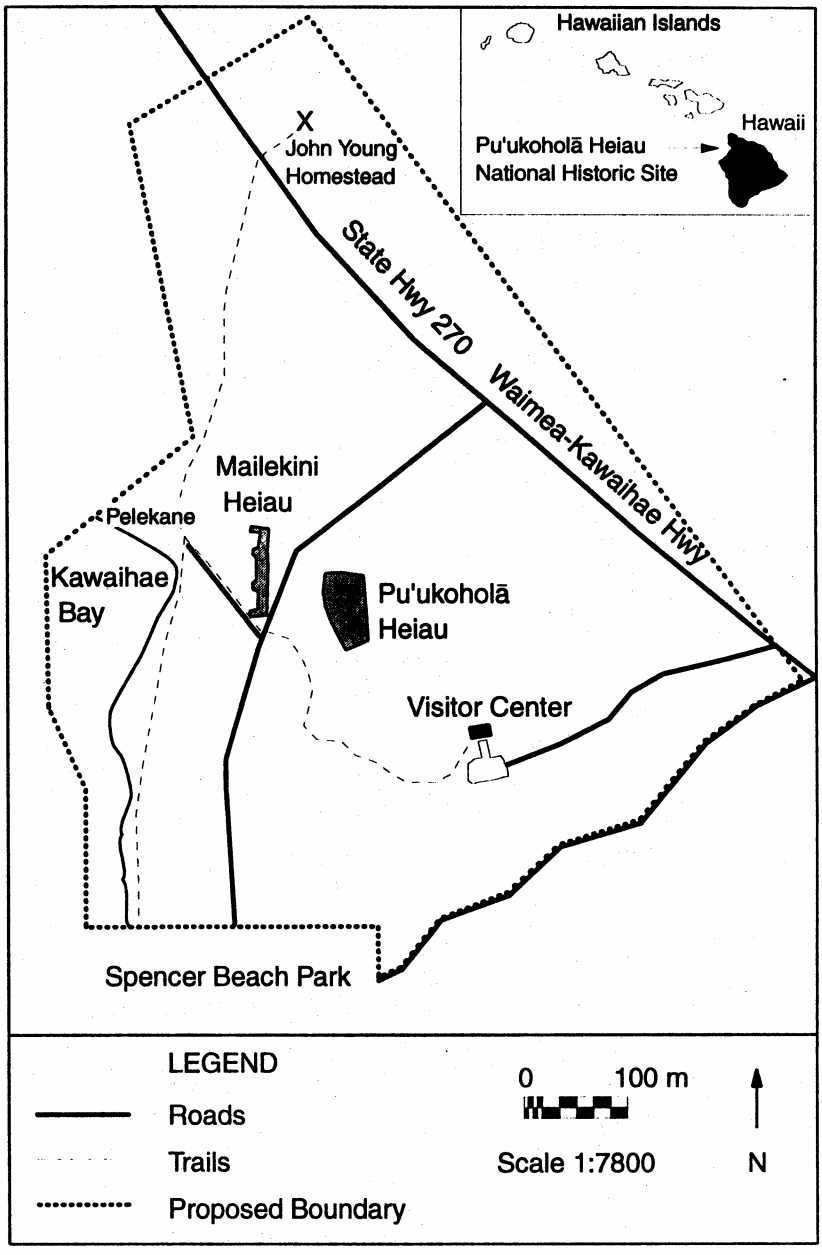

Figure 1. Roads, trails and major structures of Pu'ukoholā Heiau National Historic Site, island of Hawai'i.

mention coconut (Cocos nucifera), hala (Pandanus sp.), milo (Thespesia populnea), kou (Cordia subcordata), and loulu (Pritchardia affinis) (McEldowney 1983). The original pre-human vegetation of the Kawaihae area was probably composed of scattered native trees, shrubs, and grasses with a forest where water was available.

METHODS

Because of the small size of the Park and the prevalence of open grassland communities with good visibility, systematic transects were not used. The Park was visited three times to compile a current vascular plant checklist: October 1992, March 1993, and June 1994. Areas searched were the lawn and plantings near the Park visitor center and parking area, the area surrounding Pu'ukoholā and Mailekini Heiau, the old road to Spencer Beach Park that passes Pu'ukoholā Heiau, the gulch from the brackish pond or stream outlet on the coast to the highway, the John Young house site, and all Park trails (from the visitor center to the coast, coast to the highway near the John Young house site, and along the coast to Spencer Park). All vegetation types identified by Macneil and Hemmes (1977) were examined. Voucher specimens were made only when necessary to identify plants; these specimens were deposited in the Hawaii Volcanoes National Park Herbarium. Voucher specimens from the 1975-76 survey were reportedly deposited at Pu'ukohola NHS (Macneil and Hemmes 1977).

A checklist of vascular plant species seen during all visits was compiled. Scientific name, common name, locality information, species status, and abundance estimate are listed for each species. Wagner et al. (1990) was used for the nomenclature of flowering plants, and an unpublished list by Wagner and Wagner (1995) was followed for the scientific names of ferns. Where scientific names have changed in the last 20 years, synonyms used in the Macneil and Hemmes checklist (St. John 1973) are provided to facilitate comparisons. Common names of most flowering plants follow Wagner et al. (1990). St. John (1973) and Porter (1972) were used for common names of non-naturalized, ornamental plants and a few other aliens; Porter (1972) was also consulted for common names of ferns.

RESULTS AND DISCUSSION

One hundred four vascular plant species were found within Pu'ukoholā Heiau National Historic Site in 1992-94. Seventy of these plants (67% of the total) were alien species (introduced since 1778). Fourteen plant species in the Park (13%) were originally Polynesian introductions, 13 (13%) were indigenous, and 7 (7%) were endemic (Table 1). Only three species of ferns were found in the Park. Most of the species seen were flowering plants; these were members of 31 different dicotyledon families and 10 monocotyledon families (Table 2). The grass family was particularly well represented in the Park.

Additions to the Park's Flora - The number of plant species known from Pu'ukoholā Heiau NHS has doubled in less than 20 years. Macneil and Hemmes (1977) listed 52 vascular plant species during their 1975-76 survey; this is only half the number found during 1992-94. Sixty-eight plant species seen in the Park in 1992-94 were additions to the previous checklist of 1977. Five other plant species collected in the Park subsequent to the Macneil and Hemmes survey were identified as additions to the Park's flora by Paul Higashino in 1982; these were not resighted in 1992-94.

Several factors have contributed to the increase in the number of plant species occurring in the Park. At the time of the Macneil and Hemmes survey, the graded lawn surrounding the visitor center did not exist, and the planting of natives and Polynesian introductions had not yet begun. In the current survey, 22 previously unreported alien plant species (including one possible Polynesian introduction) were restricted to the flat, mowed area adjacent to the Park visitor center. These were primarily small grasses, sedges, and weedy herbs. Another 32 new species appeared to be intentionally planted near the visitor center. Among the plantings were eight native tree or shrub species, 12 Polynesian introductions of cultural significance, and 12 alien ornamental or fruit-bearing species. Only one of the planted alien species appeared to have spread from the vicinity of the visitor center. Several young Chinese banyan (Ficus microcarpa) trees were noted on the sides of a gulch or dry streambed upslope of Pelekane; these may be progeny of one relatively large tree in the lawn near the visitor center.

In addition to the 22 lawn species and 32 intentional plantings, there were 14 other species scattered through the Park that are new records from the 1992-94 survey. Most of these (11) were alien plants, but three indigenous species were also added to the Park's checklist. The three native plants are moa or whisk fern (Psilotum nudum) growing at the base of planted trees near the visitor center, pili (Heteropogon contortus) near Pu'ukoholā Heiau, and 'aki'aki grass (Sporobolus virginicus) on the edge of the brackish pond or stream outlet near Pelekane. These natives did not appear to be planted.

The alien plant additions were one fern, seven herbaceous species, and three shrub species; these were primarily in disturbed areas near trails and roads. The fern, scaly swordfern (Nephrolepis multiflora), was growing on the rocks of Pu'ukoholā Heiau. New herbaceous plants found along trails were a dry, unidentified grass (Vulpia sp.?), khaki weed (Alternanthera pungens), two amaranths (Amaranthus spinosus, A. lividus), graceful spurge (Chamaesyce hypericifolia), and Boerhavia coccinea. One annual vine, hedgehog gourd (Cucumis dipsaceus), was found only in a dry streambed near the highway. Three shrub species among the 1992-94 additions are most likely to persist and possibly spread. Lantana (Lantana camara) and Sacramento bur (Triumfetta semitriloba) were found along the trail from the coast to the highway near the John Young house site and in a dry streambed; sourbush (Pluchea symphytifolia) was seen only in a dry streambed and adjacent kiawe forest.

Species Not Found Within the Park in 1992-94 - Sixteen plant species listed from Pu'ukoholā Heiau National Historic Site in 1977 (Macneil and Hemmes 1977) were not seen during the current survey; these were 5 native and 11 alien species. The native plants not seen in 1992-94 were a small fern ('iwa'iwa or Doryopteris decora), an endemic shrub ('āheahea or Chenopodium oahuense), and three herbceous plants: koali 'awa (Ipomoea indica), alena (Boerhavia sp.), and nohu (Tribulus cistoides). All five of these native species were described as rare in the 1977 Park checklist, and all but 'āheahea were originally found in the scrub grassland community. 'Āheahea occurred in the Park as two 2-m (7-ft) tall shrubs in the halophytic community near the brackish pond or stream outlet. This area was searched in 1992-94, and 'āheahea shrubs were not sighted. Three of the other four native species not resighted in 1992-94 ('iwa'iwa, alena, and nohu) are small and could have been overlooked mixed among the dense buffelgrass of the scrub grassland community. 'Iwa'iwa is a seasonal fern that may be dried and unrecognizable in the summer. A more systematic search including several seasonal visits might locate these three species and koali 'awa, a climbing morning glory vine. Nohu and alena are also likely components of beach vegetation.

The 11 alien plant species of the 1977 checklist that were not resighted during the 1992-94 survey were, with two exceptions, annual herbs. These annuals, such as West Indian beggar's tick (Bidens cynapiifolia) and sowthistle (Sonchus oleraceus), will likely reappear during wet seasons, and should be considered part of the Park's flora. One vine, identified by Macneil and Hemmes (1977) as ipu (Citrullus sp.) formerly may have been cultivated in the Park. Slender mimosa (Desmanthus virgatus), a small shrub, was found infrequently in scrub grassland by Macneil and Hemmes (1977); although not seen in 1992-94, this shrub may persist away from trails.

In 1982, Paul Higashino, then of the Hawaii Volcanoes National Park Research Division, collected 10 plant species at Pu'ukoholā Heiau National Historic Site. Five of these were new records for the Park: beach wiregrass (Dactyloctenium aegyptium), carpetweed (Mollugo sp.), New Zealand spinach (Tetragonia tetragonioides), cocklebur (Xanthium strumarium), and Jimson weed (Datura stramonium). The disposition of these specimens is unknown; the new records and other collections were listed in a memo Higashino wrote to one of the Park Rangers at Pu'ukohola NHS (Higashino 1982). Higashino found beach wiregrass near the Park visitor center, New Zealand spinach on the seashore, cocklebur and Jimson weed at the John Young house site, and carpetweed at an unnamed location. While none of these plants were noted during the 1992-94 survey, they may persist in unsurveyed parts of the Park or reappear during wet months. Jimson weed may have been removed from the Park, as suggested by Higashino (1982), because it is a poisonous plant.

Native Plants - Among the 20 endemic or indigenous plant species found in the Park in 1992-94, 12 appeared to be naturally occurring rather than planted. Most of these native species were found near the shore of Kawaihae Bay in a coastal strip and near the brackish pond or stream outlet where kiawe has been cleared. These native coastal plants

such as naupaka kahakai (Scaevola sericea, also known as S. taccada), milo (Thespesia populnea), pōhuehue (Ipomoea pes-caprae), and ʻākulikuli (Sesuvium portulacastrum), are hardy and will likely persist and even spread, particularly if kiawe clearing continues. Hala (Pandanus tectorius) trees found near the coast were probably planted, but like coconut (Cocos nucifera), a Polynesian introduction, they are appropriate to this community. Two native coastal plants, kīpūkai or nena (Heliotropium curassavicum) and pāʻū o Hiʻiaka (Jacquemontia ovalifolia subsp. sandwicensis) were found in low numbers and may be vulnerable to damage if the coastal area receives heavy visitor use.

Several native plant species were found away from the coast. ʻIlima (Sida fallax) and ʻuhaloa (Waltheria indica) occurred in both kiawe forest and the open buffelgrass scrub; these shrubs are typical components of dry lowland vegetation. Pili was found at only one site near Puʻukoholā Heiau. While this native grass is not unexpected at Puʻukoholā and may have persisted in the area, it may also represent an intentional reintroduction.

The rarest native plant of Puʻukoholā Heiau NHS is the tiny seasonal fern pololei (Ophioglossum polyphyllum, formerly known as O. concinnum). This species persists in the Park in the area between the visitor center and the Waimea-Kawaihae Highway. One plant was noted in October 1992 growing with buffelgrass near a rock wall. Until 1993, this fern was a candidate for listing as an endangered species. Because it may be more properly identified as an indigenous fern more widely distributed and common outside Hawaiʻi (Wagner and Wagner 1995), the species was removed from the list of endangered species candidates maintained by the U.S. Fish and Wildlife Service (Smith 1993). Because it appears only seasonally, pololei is often overlooked in its coastal habitat; the fern may be more common in Hawaiʻi than previously thought (C. H. Lamoureux, pers. comm. 1995).

Plantings of native species were, with the possible exception of hala, restricted to the cultivated area near the Park visitor center. Most of these outplanted species were plants of the dry lowlands. Trees and shrubs such as wiliwili (Erythrina sandwicensis), ʻaʻaliʻi (Dodonaea viscosa), and ʻākia (Wikstroemia sp.) may have been among the original components of vegetation in the dry leeward lowlands near Puʻukoholā. Hala and loulu palms (Pritchardia sp.) may have been native to the coast near Kawaihae and were likely cultivated or encouraged by Hawaiian inhabitants of the area (McEldowney 1983). The native yellow hibiscus or maʻo hau hele (Hibiscus brackenridgei), an endangered species, is not known from the Kawaihae area, but naturally occurred near Puʻu Anahulu approximately 24 km (15 mi) to the south of the Park (U.S. Fish and Wildlife Service 1993). One native species planted at Puʻukoholā Heiau NHS, maʻo or Hawaiian cotton (Gossypium tomentosum), is not known from the Kawaihae region, and has never been collected wild from the island of Hawaiʻi (Wagner et al. 1990).

Vegetation and Alien Plants - Five plant communities were described and mapped within Pu'ukoholā Heiau NHS by Macneil and Hemmes (1977): scrub grassland, coastal closed forest, fluvial closed forest, halophytic community, and a disturbed roadside community. All five communities were still present in 1992-94, although their boundaries have changed over the last two decades. The coastal kiawe forest mapped along the Park's coast to Spencer Beach Park seems to have been reduced, perhaps by kiawe clearing. A narrow strip of native strand plants is now present along some of the Park's shoreline.

The current survey added 44 alien species to the Park's known flora, as well as several native species and both native and Polynesian plantings. The percentage of alien plants in Pu'ukoholā Heiau NHS has changed very little in the last two decades. Seventy-one percent of the Park's vascular plant species were alien in 1975-76 (Macneil and Hemmes 1977), and 67% of the species found during the current survey were alien.

Macneil and Hemmes (1977) singled out two alien plant species as potentially noxious: ēkoa or koa haole (Leucaena leucocephala) and castor bean (Ricinus communis). Neither species has greatly spread or increased abundance in the interval between surveys. Ēkoa was found scattered at low density in the open scrub grassland community in 1977; in 1992-94 the shrub was infrequently seen in both the grassland community and the fluvial kiawe forest. Castor bean was rated as infrequent in scrub grassland, fluvial forest, and coastal forest in 1977; in the current survey the shrub was found only in kiawe forest along the trail from the John Young house to the coast and in a dry gulch or streambed. Three alien species found within the Park are currently designated as noxious weeds or have been recently deleted from a list maintained by the Hawaii State Department of Agriculture (1991); these are fountain grass (Pennisetum setaceum), puncture vine (Tribulus terrestris), and Sacramento bur (Triumfetta semitriloba).

Recommendations - The large number of additions to the Park's flora over the last twenty years indicates that this lowland area is subject to an influx of alien species. Differences in the number and species of native plants and alien annual herbs noted during the two surveys suggest that the composition of the Park's flora fluctuates over a long period of years and also changes seasonally. Future surveys or plant checklist updates to evaluate alien plant threats and the status of native species should include several visits to the Park throughout a year, including visits in the winter and spring months.

Recent plantings and other Park Service activities, such as creation of a lawn, have added significantly to the number of species in the Park. Importation of soil, mulch, or grass seeds associated with outplanting projects will likely lead to the introduction of additional alien plants to the Park. A planting plan including a list of species planted, location of planting, and source of propagation material is essential for future evaluation of the Park's flora, particularly if planted species become established and spread. Future

plantings should only be undertaken after completion of an outplanting plan. Outplanting guidelines, such as the National Park Service guidelines for revegetation in disturbed areas (NPS 1993), should be consulted during development of a Park planting plan. Other rare species outplanting guidelines under development by the Center for Plant Conservation and Hawaiian arboreta (Woolliams and Llop 1993) would likely offer useful guidance in the selection of species to outplant, documentation and record-keeping, and accepted outplanting techniques to reduce the introduction of insect pests and plant pathogens.

While much of the Park is covered with alien plants, a few species are particularly noxious or invasive. Some of these, such as kiawe and buffelgrass, are already too widespread to completely remove from the Park. Kiawe clearing has been carried out in a few areas to reduce the likelihood and intensity of fires (Jack Minassian pers. comm. 1994); such clearing may allow natives to become re-established, particularly at coastal sites. Additional alien plants, including those invasive species currently present at low levels, might be targeted for control or eradication. Such a program to control localized alien plants has been very sucessful at Hawaii Volcanoes National Park (Tunison and Zimmer 1993). A few obvious candidates for localized alien species control are puncture vine, African tulip tree (Spathodea campanulata), autograph tree (Clusia rosea), and Chinese banyan. All of these species have the potential to spread more widely in the Park, and both banyan and autograph tree could be very destructive to archaeological sites if they became well established.

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TABLE 1. Summary of Vascular Plants at Pu'ukoholā Heiau National Historic Site, 1992-94.

Plant Group and Status	Number of Species**	(% of total)
Ferns and Fern Allies	3	
Endemic	0	
Indigenous	2	(67%)
Alien	1	(33%)
Flowering Plants - Dicotyledons	67	
Endemic	6	(9%)
Indigenous	8	(12%)
Polynesian Introductions	8	(12%)
Alien	45	(67%)
Flowering Plants - Monocotyledons	34	
Endemic	1	(3%)
Indigenous	3	(9%)
Polynesian Introductions	6	(18%)
Alien	24	(71%)
Total- Vascular Plants	104	
Endemic	7	(7%)
Indigenous	13	(13%)
Polynesian Introductions	14	(13%)
Alien	70	(67%)

** Does not include those species on earlier checklists (Macneil and Hemmes 1977, Higashino 1982) that were not seen in 1992-94 survey (noted with ! in status column of Table 2).

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist

ANNOTATIONS AND SYMBOLS

Status:

E = Endemic, native and unique to the Hawaiian Islands.

I = Indigenous, native to the Hawaiian Islands and other lands.

P = Polynesian introduction, introduced prior to 1778.

A = Alien, non-indigenous, introduced after 1778, exotic.

* = New record for the Park in 1992-94; not on Macneil and Hemmes (1977) plant checklist.

** = New record for the Park added by Paul Higashino in 1982; not on Macneil and Hemmes (1977) plant checklist.

! = Species on Macneil and Hemmes (1977) plant checklist or Higashino (1982) addition, but not seen during 1992-94 survey.

Abundance Ratings:

A = Abundant

C = Common, numerous and widespread

O = Occasional, scattered in many localities in Park

U = Uncommon, infrequent, few plants scattered or localized

R = Rare, one or very few plants seen

lc = Localized

Voucher Specimens:

A few specimens were collected for identification. These are indicated by the collector's initials and number in parentheses at the end of the entry for each collected plant (Lyman L. Abbott or Linda W. Pratt). Specimens were deposited at the Hawaii Volcanoes National Park Herbarium.

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
FERNS AND FERN ALLIES		
DRYOPTERIDACEAE (NEPHROLEPIDOIDEAE) - WOODFERN FAMILY (SWORDFERN SUBFAMILY)		
Nephrolepis multiflora (Roxb.) F. M. Jarrett ex C. V. Morton (Syn: Nephrolepis hirsutula) Scaly swordfern Large fern growing in clumps on rock walls of heiau.	A*	U
OPHIOGLOSSACEAE - ADDER'S TONGUE FERN FAMILY		
Ophioglossum polyphyllum A. Braun (Syn: Ophioglossum concinnum Brack.) Pololei One individual seen near rock wall mauka of Park visitor center. This fern was formerly a Candidate Endangered Species (Category 1), but appears to be more common than previously thought.	I	R
PSILOTACEAE - WHISK FERN FAMLY		
Psilotum nudum (L.) P. Beauv. Moa, pipi, whisk fern Small terrestrial herb growing among plantings near Park visitor center.	I *	R
PTERIDACEAE (CHEILANTHOIDEAE) - PTERIS FAMILY (LIPFERN SUBFAMILY)		
Doryopteris decora Brack. 'Iwa'iwa Not seen in 1992-94. Rare in 1977.	E !	

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
FLOWERING PLANTS - DICOTYLEDONS (MAGNOLIOPSIDA)		
AIZOACEAE - FIG-MARIGOLD FAMILY		
Sesuvium portulacastrum (L.) L. 'Ākulikuli, sea purslane Succulent herb found along shoreline trail and at edge of brackish pond or stream outlet.	I	O
Tetragonia tetragonioides (Pall.) Kuntze New Zealand spinach Reported by Higashino (1982) from coast below Mailekini Heiau; not seen in 1992-94.	A **!	
AMARANTHACEAE - AMARANTH FAMILY		
Alternanthera pungens Kunth Khaki weed Small prostrate herb found along trail from highway to coast (LWP 2520).	A *	U
Amaranthus dubius Mart. ex Thell. Spleen amaranth Not seen in 1992-94. Infrequent in 1977.	A !	
Amaranthus lividus L. Amaranth Large herb on trail from highway to coast.	A *	U
Amaranthus spinosus L. Spiny amaranth Large spiny herb in dry stream bed north of Pelekane.	A *	U

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
ASTERACEAE (COMPOSITAE) - SUNFLOWER FAMILY		
Bidens cynapiifolia Kunth West Indian beggar's tick Not seen in 1992-94. Infrequent in 1977.	A !	
Conyza bonariensis (L.) Cronq. Hairy fleabane Large herb found near Park visitor center.	A *	U
Emilia fosbergii Nicolson Pualele Small herb near Park visitor center.	A *	U
Emilia sonchifolia (L.) DC. Flora's paintbrush Not seen in 1992-94. Rare in 1977.	A !	
Gnaphalium purpureum L. (Syn: Gnaphalium peregrinum) Purple cudweed Not seen in 1992-94. Rare in 1977.	A !	
Pluchea symphytifolia (Mill.) Gillis Sourbush Large shrub on dry streambed and in kiawe forest.	A *	U
Sonchus oleraceus L. Sow thistle Not seen in 1992-94. Rare in 1977.	A !	
Tridax procumbens L. Coat buttons Perennial herb on side of old road to Spencer Park.	A	R
Xanthium strumarium L. (Syn: Xanthium saccharatum) Cocklebur, kīkānia Reported by Higashino (1982) from John Young house site; not seen in 1992-94.	A **!	

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
BATACEAE - SALTWORT FAMILY		
Batis maritima L. Pickleweed, 'ākulikuli kai Sprawling succulent shrub found only along bank of brackish pond near coast.	A	O,lc
BIGNONIACEAE - BIGNONIA FAMILY		
Spathodea campanulata P. Beauv. African tulip tree Ornamental tree planted near Park visitor center. Should be removed before it spreads from planting.	A *	R
BORAGINACEAE - BORAGE FAMILY		
Cordia subcordata Lam. Kou Tree planted near Park visitor center.	P *	R
Heliotropium curassavicum L. Kīpūkai, nena, seaside heliotrope Prostrate, succulent herb along coast and near stream.	I	R
Tournefortia argentea L. fil. (Syn: Messerschmidia argentea) Tree heliotrope Shrubby tree along coastal trail and at Pelekane.	A	O

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
CAPPARACEAE - CAPER FAMILY		
Cleome gynandra L. (Syn: Gynandropsis gynandra) Wild spider flower White-flowered herb near Park visitor center, at John Young house site, along trail from Mailekini Heiau to shore, and on dry streambed.	A	O
CARICACEAE - PAPAYA FAMILY		
Carica papaya L. Papaya Planted near Park visitor center.	A *	R
CHENOPODIACEAE - GOOSEFOOT FAMILY		
Atriplex johnstonii Wolf Saltbush Not seen in 1992-94. Rare in 1977.	A !	
Atriplex semibaccata R. Br. Australian saltbush Low, mat-forming, succulent herb along trails from highway to shoreline and visitor center to Mailekini Heiau, also on heiau.	A	O
Atriplex suberecta Verd. (Syn: Atriplex muelleri) Saltbush Succulent herb on coastal trail near brackish pond.	A	U
Chenopodium murale L. Nettle-leaved goosefoot, 'āheahea Large herb at John Young house site and along trail near coast (LWP 2519).	A	U

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
CHENOPODIACEAE - GOOSEFOOT FAMILY (Continued)		
Chenopodium oahuense (Meyen) Aellen 'Āheahea, 'āweoweo, Not seen in 1992-94. Rare in 1977.	E !	
CLUSIACEAE (GUTTIFERAE) - MANGOSTEEN FAMILY		
Calophyllum inophyllum L. Kamani Trees planted near Park visitor center.	P *	U
Clusia rosea Jacq. Autograph tree One small tree among plantings near Park visitor center.	A *	R
CONVOLVULACEAE - MORNING GLORY FAMILY		
Ipomoea batatas (L.) Lam. 'Uala, sweet potato Vine planted near Park visitor center.	P *	R
Ipomoea indica (J. Burm.) Merr. (Syn: Ipomoea congesta) Koali 'awa, koali 'awahia Not seen in 1992-94. Rare in 1977.	I !	
Ipomoea pes-caprae (L.) R. Br. subsp. brasiliensis (L.) Ooststr. Pōhuehue, beach morning glory Robust terrestrial vine along coastal trail.	I	U

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
CONVOLVULACEAE - MORNING GLORY FAMILY (Continued)		
Jacquemontia ovalifolia (Choisy) H. Hallier subsp. sandwicensis (A. Gray) K. Robertson (Syn: Jacquemontia sandwicensis) Pā'ū o Hi'iaka Slender vine near Pelekane and on coastal trail.	E	R
Merremia aegyptia (L.) Urb. Hairy merremia Vine found at John Young house site, on trail to Mailekini Heiau, and on heiau.	A?	U
CUCURBITACEAE - GOURD FAMILY		
Citrullus sp. Ipu Not seen in 1992-94. Rare in 1977.	A !	
Cucumis dipsaceus Ehrenb. ex Spach Hedgehog gourd, teasel gourd Vine growing on alien grasses in dry streambed (LWP 2794).	A *	R
Lagenaria siceraria (Molina) Standl. Ipu, bottle gourd Vine planted near Park visitor center.	P *	R
EUPHORBIACEAE - SPURGE FAMILY		
Aleurites moluccana (L.) Willd. Kukui, candlenut Tree planted near Park visitor center.	P *	R

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
EUPHORBIACEAE - SPURGE FAMILY (Continued)		
Chamaesyce hirta (L.) Millsp. (Syn: Euphorbia hirta) Hairy spurge Small herb in lawn near Park visitor center, along trail to Mailekini Heiau, and in dry streambed.	A	U
Chamaesyce hypericifolia (L.) Millsp. (Syn: Euphorbia glomerifera) Graceful spurge Erect herb along trail to Mailekini Heiau.	A *	R
Chamaesyce prostrata (Aiton) Small (Syn: Euphorbia prostrata) Prostrate spurge Small prostrate herb in lawn near Park visitor center. (LWP sn)	A *	U
Euphorbia heterophylla L. (Syn: Euphorbia geniculata) Kaliko Only one sterile plant seen along trail from coast to Mailekini Heiau (LWP 2518).	A	R
Ricinus communis L. Castor bean Shrub along trail from highway to shoreline and in dry streambed.	A	U
FABACEAE (LEGUMINOSAE) - PEA FAMILY		
Acacia koa A. Gray Koa One tree planted near Park visitor center.	E *	R
Desmanthus virgatus (L.) Willd. Slender mimosa Not seen in 1992-94. Infrequent in 1977.	A !	

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
FABACEAE - PEA FAMILY (Continued)		
Desmodium sandwicense E. Mey. (Syn: Desmodium uncinatum) Spanish clover Shrubby herb in lawn near Park visitor center.	A *	U
Erythrina sandwicensis Degener Wiliwili Tree planted near Park visitor center.	E *	R
Leucaena leucocephala (Lam.) de Wit Ēkoa, koa haole Shrub beneath kiawe along trail through forest, also in dry streambed.	A	U
Medicago lupulina L. Black medick Small herb in lawn near Park visitor center.	A *	U
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth Kiawe, mesquite Most common tree in Park, particularly dense near coast and along stream.	A	A
Samanea saman (Jacq.) Merr. Monkeypod Tree planted near Park visitor center.	A *	R
GOODENIACEAE - GOODENIA FAMILY		
Scaevola sericea Vahl (Syn: Scaevola taccada) Naupaka kahakai Shrub along coast and planted near Park visitor center. Some botanists believe that the formerly used scientific name, S. taccada, is the correct one.	I	R

TABLE 2. Pu'ukoholā Heiau National Historic site Vascular Plant Checklist (Continued)

	Status	Abundance
MALVACEAE - MALLOW FAMILY		
Abutilon grandifolium (Willd.) Sweet Hairy abutilon Shrub along trail from highway to coast, along trail to Mailekini Heiau, and on dry streambed.	A	O
Gossypium tomentosum Nutt. ex Seem. Ma'o, Hawaiian cotton Shrub planted near Park visitor center.	E *	R
Hibiscus brackenridgei A. Gray subsp. brackenridgei Ma'o hau hele Shrub planted near Park visitor center; this is a listed endangered species.	E *	R
Sida fallax Walp. 'Ilima Shrub along trail from highway to coast, on Mailekini Heiau, and on dry streambed.	I	U
Thespesia populnea (L.) Sol. ex Correa Milo Tree along coast trail and bank of brackish pond; also planted near Park visitor center.	I	O
MOLLUGINACEAE - CARPETWEED FAMILY		
Mollugo sp. Carpetweed Reported by Higashino (1982); not seen in 1992-94. May be Mollugo cerviana (L.) Ser., threadstem carpetweed, a species known from dry lowland sites on Hawai'i Island (Wagner et al. 1990).	A **!	

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
MORACEAE - MULBERRY FAMILY		
Broussonetia papyrifera (L.) Venten. Wauke, paper mulberry Shrub planted near Park visitor center.	P *	R
Ficus microcarpa L. fil. Chinese banyan Tree planted near Park visitor center; young trees on edge of dry streambed.	A *	R
NYCTAGINACEAE - FOUR-O'CLOCK FAMILY		
Boerhavia coccinea Mill. No common name Herb in lawn near Park visitor center and along trail from highway to coast.	A *	U
Boerhavia sp. (Syn: Boerhavia diffusa) Alena Not seen in 1992-94. Rare in 1977. Plants previously called B. diffusa in Hawai'i are now placed in either Boerhavia repens L. or Boerhavia glabrata Blume.	I !	
OXALIDACEAE - WOOD SORREL FAMILY		
Oxalis corniculata L. Yellow wood sorrel, 'ihi 'ai Small herb in lawn near plantings at Park visitor center.	P? *	R
PASSIFLORACEAE - PASSION FLOWER FAMILY		
Passiflora foetida L. Love-in-a-mist, scarlet-fruited passion flower Few vines seen along dry streambed.	A	R

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
PLANTAGINACEAE - PLANTAGO FAMILY		
Plantago australis Lam. subsp. hirtella (Kunth) Rahn Dwarf plantain Herb in lawn near Park visitor center.	A *	U
Plantago lanceolata L. Narrow-leaved plantain Herb in lawn near Park visitor center.	A *	U
PORTULACACEAE - PURSLANE FAMILY		
Portulaca oleracea L. Pigweed, common purslane On dry streambed and along trails.	A	U
Portulaca pilosa L. (Syn: Portulaca cyanosperma) No common name Prostrate, succulent herb in dry stream bed and near coast.	A	U
RUBIACEAE - COFFEE FAMILY		
Hedyotis corymbosa (L.) Lam. No common name Tiny herb in lawn near Park visitor center (LWP sn).	A *	U
Morinda citrifolia L. Noni, Indian mulberry Shrub planted near Park visitor center.	P *	R
Spermacoce sp. Buttonweed Herb in lawn near Park visitor center (LWP 2521).	A *	U

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
RUTACEAE - RUE FAMILY		
Citrus sp. Citrus, species unknown Fruit tree planted near Park visitor center; sterile at time of survey.	A *	R
SAPINDACEAE - SOAPBERRY FAMILY		
Dodonaea viscosa Jacq. 'A'ali'i Several shrubs planted at edge of lawn near Park visitor center.	I *	R
SOLANACEAE - NIGHTSHADE FAMILY		
Capsicum annuum L. Cayenne pepper Cultivated in pot near Park visitor center.	A *	R
Capsicum frutescens L. Bird pepper Small shrub planted near Park visitor center. Some botanists do not distinguish between this species and C. annuum.	A *	R
Datura stramonium L. Jimson weed Reported by Higashino (1982) from John Young house site; not seen in 1992-94.	A **!	
Lycopersicon pimpinellifolium (Jusl.) Mill. Currant tomato Not seen in 1992-94. Listed as rare in 1977.	A !	

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
STERCULIACEAE - CACAO FAMILY		
Waltheria indica L. (Syn: Waltheria americana) 'Uhaloa, hi'aloa Low shrub scattered throughout Park, near visitor center, at John Young house site, and along trails from highway to coast.	I	O
THYMELAEACEAE - 'AKIA FAMILY		
Wikstroemia sp. 'Ākia One shrub planted near Park visitor center.	E *	R
TILIACEAE - LINDEN FAMILY		
Triumfetta semitriloba Jacq. Sacramento bur Few plants along trail from highway to coast and on dry streambed.	A *	U
VERBENACEAE - VERBENA FAMILY		
Lantana camara L. Lantana Thorny shrub along trail from highway to coast and on dry streambed.	A *	O
ZYGOPHYLLACEAE - CREOSOTE BUSH FAMILY		
Tribulus cistoides L. Nohu Not seen in 1992-94. Listed as rare in 1977.	I !	

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
ZYGOPHYLLACEAE - CREOSOTE BUSH FAMILY (Continued)		
Tribulus terrestris L. Puncture vine Prostrate herb at John Young house site and along Park trails below Mailekini Heiau.	A	O
UNKNOWN FAMILY		
Unknown species One shrub planted near Park visitor center (LWP 2795).	A *	R
FLOWERING PLANTS - MONOCOTS (LILIOPSIDA)		
AGAVACEAE - AGAVE FAMILY		
Cordyline fruticosa (L.) A. Chev. (Syn: Cordyline terminalis) Kī, ti Shrub planted near Park visitor center; both green and red forms present.	P *	U
Pleomele marginata (Lam.) N.E. Br. Money tree Ornamental shrub planted near Park visitor center.	A *	R
ARECACEAE (PALMAE) - PALM FAMILY		
Cocos nucifera L. Niu, coconut Trees along shoreline.	P	O
Phoenix canariensis Hort. ex Chabaud Canary Island date palm Tree on edge of brackish pond.	A	R

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
ARECACEAE (PALMAE) - PALM FAMILY (Continued)		
Pritchardia sp. Loulu Row of young trees planted at edge of lawn near Park visitor center. Probably Pritchardia affinis, an endangered species native to leeward Hawai'i Island.	E? *	R
BROMELIACEAE - BROMELIAD FAMILY		
Ananas comosus (L.) Merr. Pineapple Planted near Park visitor center.	A *	R
CYPERACEAE - SEDGE FAMILY		
Kyllinga brevifolia Rottb. (Syn: Cyperus brevifolius) Kili'o'opu Small sedge in lawn near Park visitor center.	A *	U
Kyllinga nemoralis (J.R. Forster & G. Forster) Dandy ex Hutchinson & Dalziel (Syn: Cyperus kyllinga) Kili'o'opu Small sedge in lawn near Park visitor center.	A *	U
LILIACEAE - LILY FAMILY		
Aloe vera L. Aloe Succulent herb planted near Park visitor center.	A *	R

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
MUSACEAE - BANANA FAMILY		
Musa x paradisiaca L. Mai'a, banana Planted near Park visitor center.	P *	R
PANDANACEAE - SCREW PINE FAMILY		
Pandanus tectorius S. Parkinson ex Z. Hala Trees planted near Park visitor center, also found along shoreline trail and at Pelekane.	I *	U
Pandanus sp. Hala Tree planted near visitor center. Cultivar with white-striped leaves. Many species of Pandanus from other tropical lands are planted as ornamentals in Hawai'i (Neal 1965).	A? *	R
POACEAE (GRAMINEAE) - GRASS FAMILY		
Aristida adscensionis L. Sixweeks threeawn Not seen in 1992-94. Listed as infrequent in 1977.	A !	
Axonopus sp. Carpetgrass In lawn near Park visitor center.	A *	U
Cenchrus ciliaris L. (Syn: Pennisetum ciliare) Buffelgrass Most abundant and widely distributed grass in Park; found at John Young house site and in open vegetation from highway to coast.	A	A

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
POACEAE (GRAMINEAE) - GRASS FAMILY (Continued)		
Cenchrus echinatus L. Common sandbur In lawn near Park visitor center.	A *	U
Chloris barbata (L.) Sw. (Syn: Chloris inflata) Swollen fingergrass In lawn near Park visitor center and near coast at Pelekane (LWP sn).	A	U
Chloris virgata Sw. Feather fingergrass Not seen in 1992-94. Listed as infrequent in 1977.	A !	
Cynodon dactylon (L.) Pers. Bermuda grass, mānienie haole In lawn near Park visitor center.	A *	U
Dactyloctenium aegyptium (L.) Willd. Beach wiregrass Reported by Higashino (1982) from area 100 m from visitor center, not seen in 1992-94.	A **!	
Digitaria fuscescens (K. Presl) Henr. Creeping kūkaepua'a In lawn near Park visitor center.	A *	U
Digitaria sp. Crabgrass In lawn near Park visitor center (LWP sn).	A *	U
Eleusine indica (L.) Gaertn. Wiregrass In lawn near Park visitor center.	A *	U
Eragrostis cilianensis (All.) Link Stinkgrass At John Young house site.	A	U

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

POACEAE (GRAMINEAE) - GRASS FAMILY (Continued)	Status	Abundance
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult. Japanese lovegrass In lawn near Park visitor center.	A *	U
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult. Pili Few plants found at base of Pu'ukoholā Heiau.	I *	R
Panicum maximum Jacq. Guinea grass Large grass in dry streambed and kiawe forest near coast.	A	R
Paspalum conjugatum Bergius Hilo grass In lawn near Park visitor center.	A *	U
Pennisetum setaceum (Forssk.) Chiov. Fountain grass Large bunchgrass primarily along roadsides and trails.	A	C
Rhynchelytrum repens (Willd.) Hubb. (Syn: Tricholaena rosea) Natal redtop In dry streambed.	A	U
Saccharum officinarum L. Kō, sugarcane Planted near Park visitor center.	P *	R
Setaria verticillata (L.) P. Beauv. Bristly foxtail Seen only in kiawe forest of dry streambed.	A	R

TABLE 2. Pu'ukoholā Heiau National Historic Site Vascular Plant Checklist (Continued)

	Status	Abundance
POACEAE (GRAMINEAE) - GRASS FAMILY (Continued)		
Sporobolus indicus (L.) R. Br. West Indian dropseed. In lawn near Park visitor center.	A *	U
Sporobolus virginicus (L.) Kunth 'Aki'aki, beach dropseed Creeping grass locally common on banks of stream near coast.	I *	C,lc
Vulpia sp.? Fescue One dry plant seen on old road to Spencer Park; not enough fertile material available to identify to species.	A *	R
TACCACEAE - TACCA FAMILY		
Tacca leontopetaloides (L.) Kuntze Pia, Polynesian arrowroot Planted near Park visitor center.	P *	R
ZINGIBERACEAE - GINGER FAMILY		
Curcuma longa L. 'Ōlena, turmeric Planted near Park visitor center.	P *	R